EE565: Video Communications

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Spring 2007

Homework #5

Due: Thursday, April 26, 2007

The goal of this homework is to demonstrate the energy compaction properties of the KLT. You are asked to do the following:

1. Load the *Cameraman* image in Matlab and partition it into 8×8 blocks.
2. Rearrange each 8×8 block into a 64×1 vector using lexicographic ordering (concatenate each row of the block into a vector). Thus, you will have created 1024 vectors $\underline{s}_i$, $i = 1, \ldots, 1024$ (the original image is of size 256×256.
3. Estimate the mean of the data vectors as

$$\underline{\eta}_s = \frac{1}{1024} \sum_{i=1}^{1024} \underline{s}_i$$

   Estimate the covariance matrix of the data as

$$[C]_s = \frac{1}{1024} \sum_{i=1}^{1024} [(\underline{s}_i - \underline{\eta}_s)(\underline{s}_i - \underline{\eta}_s)^H]$$

4. Find the KLT inverse transform matrix $[\Phi]$.
5. Take the KLT for each image vector $\underline{s}_i$.
6. For each vector, keep only the 20 KLT coefficients with the largest magnitudes and set the rest of the coefficients to zero.
7. Take the inverse KLT of each vector. Rearrange the vectors into 8×8 blocks by inverting the lexicographic ordering procedure you used before. Display and print out the reconstructed image. Calculate and print out the Peak Signal-to-Noise Ratio (PSNR) of the reconstructed image.
8. Repeat the experiment by keeping only the 10 KLT coefficients with the largest magnitudes and setting the rest of the coefficients to zero.